RESEARCH HIGHLIGHT

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NUNAVUT HOUSING VENTILATION RESEARCH 2003-2005

INTRODUCTION

Inuit children in Nunavut and Alaska have extraordinarily high rates of severe lower respiratory tract infections (LRTI). The rate of hospitalization in the Baffin Region is in the order of 300 per year for each 1,000 infants. Treatment often requires an expensive and disruptive flight for the child and family to a southern Canadian hospital.

It is not yet clear why this rate of infection is so high. The Children's Hospital of Eastern Ontario (CHEO) wanted to verify whether the house conditions in these Northern communities, specifically the indoor air quality (IAQ), could be the cause of the high rate of illness. In collaboration with researchers from Health Canada (HC), the Nunavut Housing Corporation (NHC) and CMHC, CHEO initiated a research project on Nunavut children and their homes to look for correlations between poor IAQ and the frequency of respiratory infections.

This research highlight summarizes the results of the first two phases of this testing: a pilot project measuring IAQ in 20 Cape Dorset houses, and a study measuring ventilation rates of 100 houses from four communities. A third phase is planned for 2005-2007 which will see the installation and monitoring of specific ventilation devices intended to improve the air quality in the houses.

RESEARCH PROGRAM

Cape Dorset—20 House Pilot Study (2003)

The 20 house Cape Dorset pilot project was conducted in houses where Inuit infants with no underlying cardiopulmonary diseases live. The pilot study included

- a respiratory questionnaire
- a detailed home inspection and data collection, including a blower door airtightness test
- seven-day measurements of nitrogen dioxide (NO_2), nicotine, carbon dioxide (CO_2), relative humidity and temperature
- natural air change rate testing using Brookhaven tracer gas technology
- settled floor dust and bed dust collection, followed by biological analysis

100 House Study (Phase 2)

The 2004 to 2005 research was broader geographically, encompassing approximately 25 homes in each of four Nunavut communities: Cape Dorset, Pond Inlet, Clyde River and Igloolik. Compared to the pilot study, there were only limited field measurements. A monitor recorded three to five days of house temperature, relative humidity and CO_2. The Brookhaven tracer gas technique was used again for establishing house air change rate. There was a rudimentary inspection and questionnaire to establish the house volume and identify

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ventilation devices being used. A parallel medical questionnaire was administered and an evaluation of hospitalization data was carried out. The medical data were not available when this Highlight was being written.

RESEARCH RESULTS

The research reported in this Highlight deals with data collected with respect to the house and related air quality. For reporting on the medical survey work, please consult papers written by Kovesi et al[1].

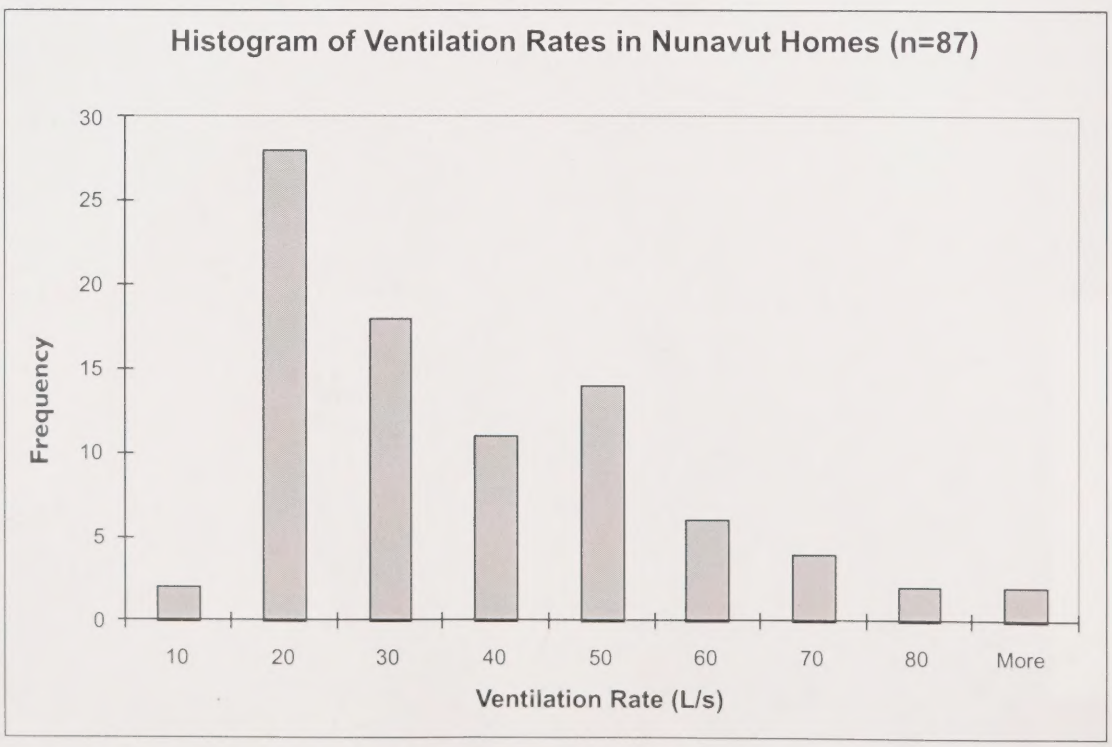
Cape Dorset 20 House Study

Nunavut houses are far smaller than their southern Canadian counterparts. While their footprint may resemble small southern houses, they are raised above the ground because of permafrost, and there are no basements. Basements add roughly 100 per cent to the volume of a bungalow and 50 per cent to a two-storey house. Without a basement there is less room for mechanical systems, material storage, play areas, and so on. As well, any pollutant introduced into the house will have a smaller amount of air to dilute its effect. In the Cape Dorset sample, the mean indoor volume was 233 m^3, which can be compared to the volume of a small new Canadian home, which is in the range of 300-450 m^3. A typical new Canadian, suburban, two-storey house, listed at a nominal 2,000 square feet, will have a volume of about 680 m^3, or roughly three times the volume of the houses measured in Cape Dorset. Another factor in air quality is the occupancy rate. In this study, an average of 6 people occupied each house with a high of 12 being observed. Having a house far smaller than a southern Canadian house with twice the occupancy will lead to different house conditions in the North. About a third of the houses showed air change rates that would be considered low by any ventilation standards, and would be very low taking into account the high occupancy of these houses.

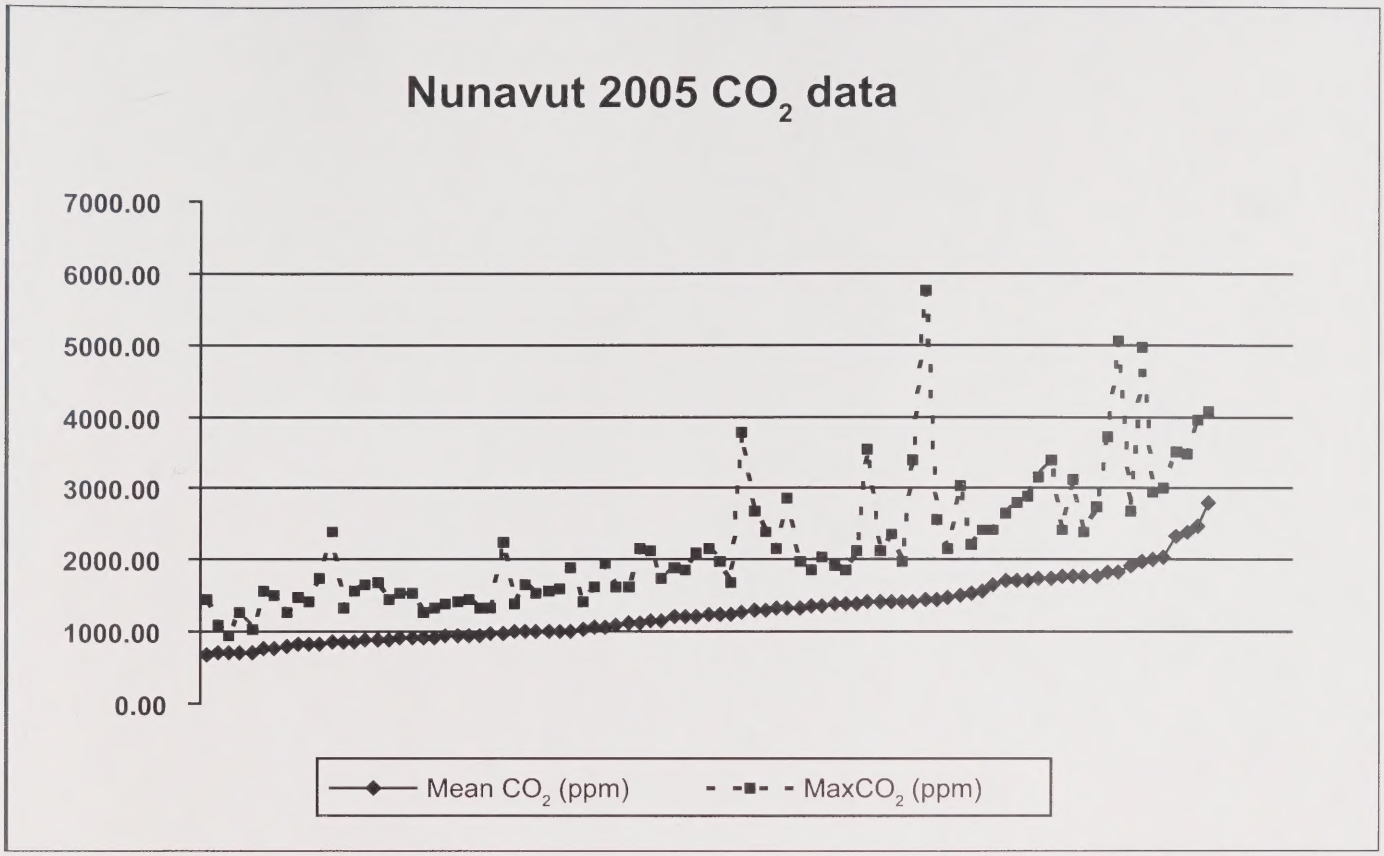
Considering that the outside winter temperatures can average -30°C, the house interior conditions were very comfortable. Inside temperatures averaged about 24°C, higher than southern houses, and the relative humidities were usually in the 15-30 per cent range. The CO_2 data obtained during the pilot study was not reliable. Most houses had resident or visiting smokers and nicotine concentrations indicated a mean of 0.84 µg/m^3 and a median value of 0.28 µg/m^3. The median NO_2 concentration, 3.7 ppb, was far lower than the current residential indoor guideline of 50 ppb. Settled house dust was similar to the few samples collected using the same protocol in southern Canadian houses. Mattress dust weights were at least 10 times higher than comparable measurements obtained in eastern Canadian sampling. Virtually no dust mites were found in the Nunavut samples, although they are ubiquitous in southern Canada.

100 House Study

The second phase of the research resulted in good-quality data being obtained from 94 houses in the four communities tested. Ventilation rates, by whatever metric (air changes per hour, L/s of outdoor air, L/s per person), were low in many houses and the CO_2 measurements reflected this lack of adequate ventilation. Note that all testing took place under winter conditions, which are very severe in Nunavut. Therefore, the natural air change rates of these houses would typically be at a heating season maximum, due to the significant stack and wind pressures during these periods.



[1] T. Kovesi, D. Creery, N. Gilbert, R. Dales, D. Fugler, B. Thompson, N. Randhawa, J.D. Miller. *Indoor Air Quality Risk Factors for Severe Lower Respiratory Tract Infections in Inuit Infants in Baffin Region, Nunavut, Canada: A Pilot Study.* Proceedings of the American Thoracic Society, Abstracts Issue, Volume 2, 2005, Page A696.



The houses above are sorted in ascending mean CO_2 concentrations with the upper points showing the maximum observed CO_2 concentration. Almost all houses indicate a mean carbon dioxide level over 1,000 ppm, and in about half the houses, the CO_2 peaks exceed 2,000 ppm. These concentrations are far higher than those seen in southern Canadian houses, and indicate the need for increased mechanical ventilation rates.

SUMMARY AND IMPLICATIONS

Inuit children in Nunavut have one of the highest rates of respiratory infection in the world. Two preliminary studies have looked at the potential effects of Nunavut housing on the transmission of disease. While many of the indoor air quality indicators were within the normal range, it is clear that a large number of Nunavut houses are not being adequately ventilated. High and variable occupancies play a part in the ventilation issues. The development and promotion of energy-efficient ventilation devices could help resolve these deficiencies.

CMHC Project Manager: Don Fugler

Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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